BROOKLYN BRIDGE PARK CONSERVANCY

POST-TRIP LESSON

SEINING THE RIVER WILD

LESSON OVERVIEW

OBJECTIVE

Students will interpret fish data statistically and create graphs to display science information.

RECOMMENDED GRADE LEVELS

4-8

DURATION

Each exercise should take 10-15 mins. There are 6 exercises total.

MATERIALS

- Graphing paper
- Ruler (recommended for graphing)
- Student worksheets (provided)
- Excel (optional)

TOPIC BACKGROUND

The East River is an **estuary** that creates a very unique environment for many different living organisms. **Community science** organizations, like Brooklyn Bridge Park Conservancy, collect data to monitor changes in the number and type of animals living in the water.

During your field trip, students were shown a data sheet which was used to record data such as: names of the organisms caught, number of each organism caught, fish lengths, and water quality parameters

Scientists often collect numerical data, as well as categorical data. **Scatter plots** and **histograms** can be used to graph numerical, continuous data, such as fish lengths or temperature. **Bar graphs** and **pie charts** are often used to compare categorical data, such as species of fish. **Box plots** and **dot charts** are commonly used for visualizing mean, median, and mode. In this lesson, students will practice statistical analysis and graphing using real, local data from the East River.

GETTING READY

1. Review the teacher procedure and math worksheets on the following pages and determine which exercises you will use with your students.
2. Print copies of the worksheets for all students.
3. Ensure students have ample graph paper for all the exercises, a ruler, and calculator if desired.
4. If you would like students to practice making graphs on excel, you can download all the data listed in this lesson plan from: **https://bit.ly/ERIAresources**
5. There are two files. The first file is for students to use Excel to graph and interpret data and includes teacher directions on the first tab. The second file (.csv) can be imported into a platform called Data Explorer for easy, automated graph creation. *https://media.hhmi.org/biointeractive/tool/dataexplorer/v1/#/home*

PROCEDURE

The following exercises are best done together, in order. However, teachers can pick and choose depending on which math concepts are appropriate for students. Each exercise has a separate worksheet and answer keys which are attached towards the end of this lesson plan. Many of the exercises will require students to use graphing paper. A printable page of graph paper is included in this packet. Teachers can also opt to have students use Excel to make graphs (see "Getting Ready" section for more information).

Exercise 1: Salinity of the East River

Students will investigate if there is a trend between salinity and temperature by reading a chart, answering questions, and creating a scatter plot.

Exercise 2: Investigating Dissolved Oxygen Levels

Students will investigate if there is a trend between dissolved oxygen and temperature by reading a chart, answering questions, and creating a scatter plot.

Exercise 3: Evaluating Fish Collection Methods

Students will be provided information about the different species of fish caught from a seining net and from rod & reel. Students will compare the diversity of catches by interpreting data from a graph and table, then answering questions.

Exercises 4-6 are a case study of striped bass in the East River. Have students read the provided 1 page article, *Case Study: Striped Bass of the East River,* for important background information before completing the worksheets. These exercises involve concepts of statistics and multi-step real world mathematical problems.

Exercise 4: Striped Bass Catch Size in Brooklyn Bridge Park

Students will be provided data on sizes of striped bass caught by rod and reel in Brooklyn Bridge Park. Students will perform a statistical analysis of the data. To do this, students should first rewrite all the data in a list in size order from smallest to largest. From there, calculate the mean, median, mode, range, max & min, and quartiles. Using their calculations, students should be able to create a box and whiskers plot.

Exercise 5: Determining Striped Bass Age

Students will be provided a large dataset of all the measurements of striped bass caught in the East River throughout 2019. They will first need to convert the striped bass measurements from cm to mm. Next they will need to categorize the data. Using the ranges provided in Table A, students should list the age class of each size measure-

PROCEDURE CON'T

ment. Finally, students should tally up the number of specimen in each age class, writing the tallies and totals in Table A. The end product is a set of frequency data that indicates how many fish collected are of each age. Students will be asked to create a histogram using the frequency data.

Exercise 6: Comparing Striped Bass Size to Collection Method

Students will now further analyze striped bass data by comparing two variables: size and collection method. Using the averages provided, students will create a bar graph. Then they will be shown the data illustrated in a different way and asked to make observations and hypotheses.

RECOMMENDED ARTICLES & BOOKS

- NYC East River Fish Species Inventory. P. Park et al.
  www.eaglehill.us/urna-pdfs-regular/urna-038-Park.pdf
- State of the Estuary 2018. Hudson River Foundation
  www.hudsonriver.org/NYNJHEPStateoftheEstuary.pdf
- *Heartbeats in the Muck: The History, Sea Life, and Environment* by John Waldman
- *The Hudson: An Illustrated Guide to the Living River* by Stephen Stanne

RECOMMENDED WEBSITES

NOAA Fisheries Species Profile: Striped Bass
www.fisheries.noaa.gov/species/atlantic-striped-bass

Real-Time River Monitoring Data at Hudson River Park
www.hudsonriverpark.org/the-park/parks-river-project/science/monitoring-our-rivers-improving-health

www.dash.hrecos.org/station/pier84

Lesson Plans: Day in the Life of the Hudson River
www.ldeo.columbia.edu/edu/k12/snapshotday/LessonPlans.html

TEACHER NOTES:

VOCABULARY

Angling: the act of fishing with a hook and line, usually attached to a rod. A recreational angler is someone who fishes with a rod for leisure or sport.

Bar graph: A graph that shows rectangles with lengths proportional to numbers as a visual way of comparing the numbers.

Biodiversity: The variety of different species in a particular habitat or ecosystem.

Box plot: a graphic representation of a distribution by a rectangle, the ends of which mark the maximum and minimum values, and in which the median and first and third quartiles are marked by lines parallel to the ends.

Community science: scientific research, data collection, etc., that involves the participation of nonscientists.

Dissolved oxygen: the amount of oxygen that is present in water.

Distribution: the frequency of occurrence or the natural geographic range or place where any item or category of items occurs.

Estuary: A semi-enclosed body of water containing both fresh and salt water.

Histogram: a graph of a frequency distribution in which rectangles with bases on the horizontal axis are given widths equal to the class intervals and heights equal to the corresponding frequencies.

Mean: the average of a data; found by adding all numbers in the data set and then dividing by the number of values in the set.

Median: the middle value when a data set is ordered from least to greatest. Taken as the average of the two middle numbers when the sequence has an even number of numbers.

Mode: the number that occurs most often in a data set.

Outlier: an observation that is well outside of the expected range of values in a study or experiment, and which is often discarded from the data set:

Quartiles: dividing the number of data points into four parts, or quarters, of more-or-less equal size.

Range: the difference between the largest and smallest value in a dataset.

Rod and reel: *see angling*

Salinity: the amount of salt in a given solution.

Scatter plot: a graph in which the values of two variables are plotted along two axes, the pattern of the resulting points revealing any correlation present.

Seining: the act of fishing with a net that hangs vertically in the water, having floats at the upper edge, sinkers at the lower, and poles on the ends.

Tidal Strait: A channel that connects two saltwater bodies. The East River is technically a tidal strait because it connects the New York Bay to the Long Island Sound.

STANDARDS

COMMON CORE ELA

- Reading Informational Text
- Speaking and Listening
- Literacy in Technical Subjects
- Literacy in Science
- Writing Standards

COMMON CORE MATH

- Counting and Cardinality
- Measurement & Data
- Statistics and Probability

NYC K-8 SCIENCE & SOCIAL STUDIES SCOPE & SEQUENCE

- Animals, Plants in their Environments
- Exploring Ecosystems
- Diversity of Life
- Animal Diversity

Name:_____

EXERCISE 1: Salinity of the East River

The East River is not a true river but rather a tidal strait that connects the Upper NY Harbor to the Long Island Sound and the Harlem River. It is also considered a part of the New York Harbor Estuary. Estuaries have brackish water, meaning they are a mixture of saltwater and freshwater. The saltiness, or salinity, of a waterbody is measured in a unit called parts per thousand.

Data on water temperature and salinity was collected at the Pier 4 Beach in Brooklyn Bridge Park throughout the summer of 2019. Look over the data, then answer the questions below.

Date	Variable 1 (x): **Temperature (°F)**	Variable 2 (y): **Salinity (ppt)**
5/30/2019	66	17.5
6/1/2019	64	20
6/12/2019	66	16.7
6/22/2019	69.9	20.8
6/26/2019	73	22.5
7/11/2019	79.3	21.7
7/13/2019	75.9	21
7/15/2019	75.9	22
7/16/2019	75	23
7/24/2019	77	18
7/25/2019	80.6	26.5
8/7/2019	77	23.1
8/10/2019	77	24
8/14/2019	75.5	23.3
8/31/2019	75.1	22.6
9/7/2019	73.9	26
10/8/2019	66.9	21.5
10/22/2019	62.1	19

1. On which date was the water temperature the highest? Lowest?

2. On which data was the salinity the highest? Lowest?

3. Create a scatter plot using graph paper. Place temperature on the x axis and use the range 60-80. Place salinity on the y axis using the range 15-28.

4. Do you notices any trends in your scatter plot? What do you notice about dates where the temperature is higher?

Name:_____

EXERCISE 2:
Investigating Dissolved Oxygen Levels

Dissolved oxygen is essential for marine life to survive. Dissolved oxygen enters the water through the atmosphere and photosynthesis of aquatic plants. Most marine animals cannot tolerate waters with less than 4 parts per million (ppm) of dissolved oxygen. Colder water typically can hold more dissolved oxygen than warmer water.

Data on water temperature and dissolved oxygen was collected at the Pier 4 Beach in Brooklyn Bridge Park throughout the summer of 2019. Look over the data, then answer the questions below.

Date	Variable 1 (x): **Temperature (°F)**	Variable 2 (y): **Dissolved Oxygen (ppm)**
5/30/2019	66	9.1
6/1/2019	64	7.5
6/12/2019	66	8
6/22/2019	69.9	6.5
6/26/2019	73	8.3
7/11/2019	79.3	6.73
7/13/2019	75.9	6.47
7/24/2019	77	5.5
7/25/2019	75	7
8/7/2019	76.8	8
8/10/2019	77	7.5
8/14/2019	75.5	5.18
8/31/2019	75.1	6.5
9/7/2019	73.9	7
10/8/2019	66.9	8.6
10/22/2019	62.1	9.5

1. On the warmest day, what was the dissolved oxygen level?
   On the coolest day, what was the dissolved oxygen level?

2. Create a scatter plot using graph paper. Place temperature on the x axis and use the range 60-80. Place dissolved oxygen on the y axis using the range 4-10.

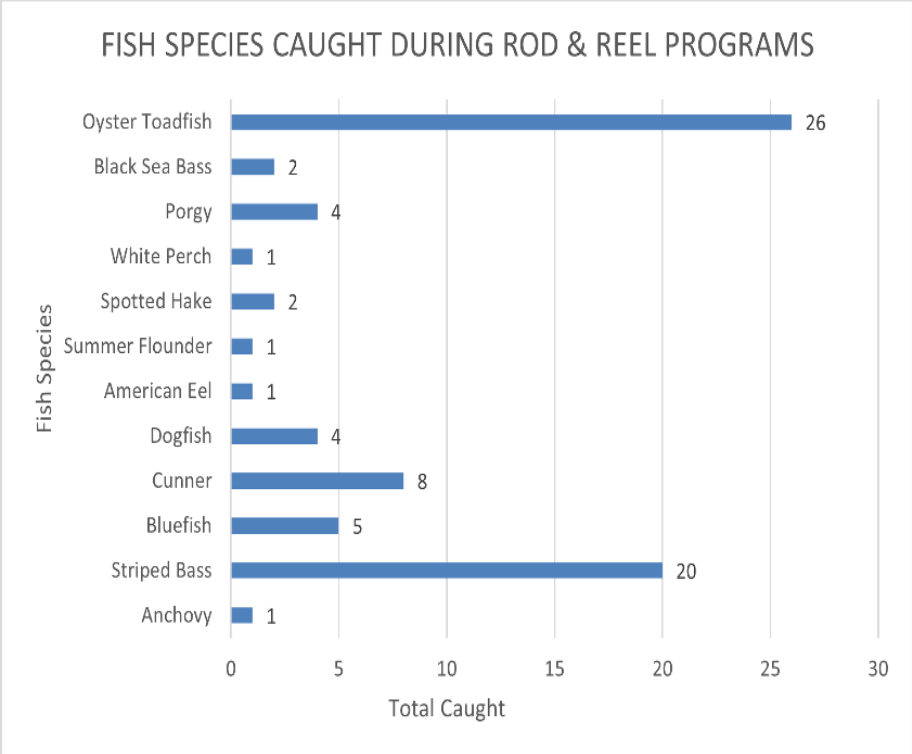
3. Do you notices any trends in your scatter plot? What do you notice about the dissolved oxygen levels on days where the temperature is higher?

4. The data above was mostly collected in summer months (June, July, August). Do you think that the average dissolved oxygen level would be much different in the winter months (December, January, February)? Explain.

Name:_____

EXERCISE 3: Evaluating Fish Collection Methods

Seining is a method of fishing where a long net is dragged through the water to gently scoop up fish. **Rod and reel** fishing entails using a hook, bait, and fishing line to catch a single fish. It is also referred to as angling. The Brooklyn Bridge Park Conservancy tracked the number of each fish species caught during every seining program and rod and reel program in 2019. The total number of species caught with each fishing method are illustrated in the figures below. Examine the two sets of data, then answer the questions .



FISH SPECIES CAUGHT DURING SEINING PROGRAMS	
American eel	2
Atlantic menhaden	104
Atlantic silverside	1435
Atlantic tomcod	44
bay anchovy	68
bluefish	28
cunner	1
flounder	3
herring	10
Atlantic needlefish	4
Northern pipefish	10
oyster toadfish	2
porgy	2
Northern puffer	2
silver perch	60
skilletfish	8
spot	3
striped anchovy	3
striped bass	8
tautog	9
white perch	1
TOTAL FISH CAUGHT	**1807**

1. Which species was mostly commonly caught during rod and reel fishing?

2. Which species was most commonly caught during seining?

3. What was the total number of fish caught during rod and reel fishing?

4. Which method of fishing collected more fish in total? Why do you think that was the case?

5. How many unique species of fish were caught from seining? From rod & reel? Speculate why there is a difference.

CASE STUDY: Striped Bass of the East River

Estuaries, like the East River, provide vital habitat, breeding areas, and migration corridors for fishes and crustaceans. While some species live in the estuary year-round or spawn in shallow marshes, many estuarine fish species are either anadromous (migrate from saltwater to freshwater to spawn) or catadromous (migrate from freshwater to saltwater to spawn). One of the most well-known and charismatic sportfish on the Atlantic Coast, the striped bass, is an anadromous species.

The Atlantic striped bass is a ray-finned fish species with a natural geographic range along the Atlantic coast from Florida to Canada. Their spawning migrations occur in major estuaries such as the Hudson River and Chesapeake Bay. Spawning typically occurs from April to May. Sexual maturity occurs sooner in males (2-3 years) than in females (5-6 years), with females typically outgrowing males. Males rarely achieve sizes of over 30 lbs. The largest known striped bass specimen was a 125lb female, caught in North Carolina in 1891 using a net. Striped bass are opportunistic predators that feed on plankton, mollusks, crustaceans, and other fish. Smaller bass, such as young-of-the-year (YOY) feed mainly on plankton while larger bass eat other fish and invertebrates.

In 2019, Atlantic striped bass data was compiled from multiple sites along the East River as part of a study called the East River Fish Project. Data contributors for this project included academic institutions, environmental education organizations, and recreational anglers, collectively known as the East River Ichthyological Alliance (ERIA). Each striped bass caught was measured before being released back into the water.

Fish data recorded came from three main types of collection efforts: the use of seine nets, fishing rods, and cages or traps. The data on striped bass collected from rod and reel fishing clinics (where youth and novice participants get a brief experience in fishing) was categorized separately from recreational angling. In total, 131 striped bass were caught and measured.

Figure A. East River Fishing clinic participant with striped bass at Brooklyn Bridge Park. (Photo by Peter J. Park)

Figure B. ERIA data collection process. Striped bass (*Morone saxatilis*) measurement method shown. (Photos by Peter J. Park)

This article is modified from *Investigating Striped Bass in New York City's East River* by Devin M. Gorsen and Peter J. Park, which can be found in:
Park, Peter J, *et al.* 2022. From Statistics to Ecological Analyses: An Application of the New York City East River Ichthyology Database (ERID) Using Spreadsheets. Article 15 In: Boone E and Thuecks S, eds. Advances in Biology Laboratory Education. Volume 42. Publication of the 42nd Conference of the Association for Biology Laboratory Education (ABLE). https://doi.org/10.37590/able.v42.art15

Name:_____

EXERCISE 4: Striped Bass Catch Size in Brooklyn Bridge Park

Throughout the summer of 2019, the Brooklyn Bridge Park Conservancy conducted numerous catch and release fishing days, using either a seine net or fishing rods. Each fish was measured in cm. The measurements can be seen below.

42.0	35.5	30.5
33.1	40.6	31.7
38.1	30.5	38.1
43.0	46.9	44.5
35.5	46.9	34.3
58.4	34.3	40.6
36.2	36.8	34.3

1. Determine the following statistics for this dataset. Show your work.
   MODE:_____

   MEADIAN: _____

   MEAN: _____

2. Are there any outliers?

3. What is the maximum and minimum value? What is the range?

4. What is the lower quartile (first quartile)? Upper quartile (third quartile)?

5. Using your calculations, create a box plot below.

Name:_____

EXERCISE 5: Analyzing Striped Bass size and age in the East River

Throughout the summer of 2019, 131 striped bass were monitored in the East River through fishing efforts such as seining, rod and reel, and traps. The total length from mouth to tail was recorded in mm for each specimen (Table B). The age of a striped bass can be approximated based on it's total length (Table A). Follow the steps below to determine the age distribution of striped bass caught.

1. Convert the data from mm to cm. Fill in the converted data into Table B. Remember 1 cm = 10 mm
2. Determine the age category of each specimen using Table A and record it in Table B.
3. Count or tally the frequency (total number of measurements) that matches each age class. Record in Table A. Double check you work. There are 131 data entries total.
4. Using graphing paper, make a histogram.
   A histogram is a type of bar graph with no spaces in between, used to depict frequencies among a set of numbers or items. Place age on the x axis and frequency on the y axis. Remember to include axis labels and a title.
5. Which age was the most common catch?

TABLE A: STRIPED BASS AGE BASED ON SIZE

Size Range (cm)	Age Class	Frequency
0- 19.9	1 year	
20 - 39.9	2 years	
40 - 45.9	3 years	
46—53.5	4 years	
53.6 -58.5	5 years	
58.6 - 63.5	6 years	
63.5 - 68.5	7 years	
68.6– 73.6	8 years	
73.7 - 78.7	9 years	
78. 8 - 86.4	10 years	
86. 5 - 91.4	11 years	
91.5 +	12 plus years	

TABLE B: STRIPED BASS SPECIMEN LENGTHS

Size (mm)	Size (cm)	Age Class
889		
711.2		
71.1		
99.1		
101.6		
121.9		
127		
127		
132.1		
160		
177.8		
177.8		
177.8		
177.8		
203.2		
203.2		
203.2		
215.9		
254		
254		
254		
254		
254		
254		
254		
259.1		
266.7		
266.7		
279.4		
279.4		
279.4		

DATASET CONTINUES ON NEXT PAGE →

TABLE B: STRIPED BASS SPECIMEN LENGTHS (CON'T)

Size (mm)	Size (cm)	Age Class
304.8		
304.8		
309.9		
317.5		
325.1		
330.2		
330.2		
340.4		
342.9		
342.9		
350.5		
355.6		
355.6		
355.6		
355.6		
355.6		
355.6		
363.2		
368.3		
381		
381		
381		
381		
381		
381		
381		
381		
393.7		
393.7		
393.7		
398.8		
406.4		
406.4		
406.4		
414		
419.1		
429.3		
431.8		
431.8		
444.5		
457.2		
469.9		
469.9		
469.9		
469.9		
477.5		
482.6		
482.6		
482.6		
482.6		

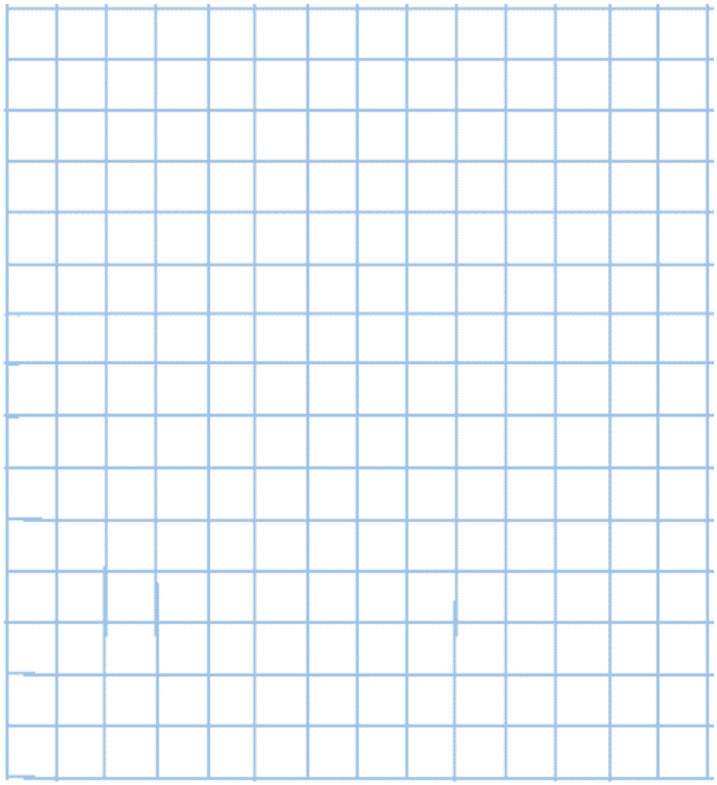
Size (mm)	Size (cm)	Age Class
485.1		
490.2		
495.3		
502.9		
508		
584.2		
584.2		
584.2		
609.6		
609.6		
609.6		
609.6		
609.6		
635		
635		
635		
660.4		
660.4		
660.4		
711.2		
711.2		
711.2		
711.2		
711.2		
736.6		
736.6		
762		
762		
762		
787.4		
812.8		
838.2		
838.2		
838.2		
838.2		
838.2		
838.2		
863.6		
863.6		
965.2		
972.8		
279.4		
279.4		
299.7		
304.8		
304.8		
304.8		
304.8		
304.8		
304.8		

Name:_____

EXERCISE 6: Comparing Striped Bass Size to Collection Method

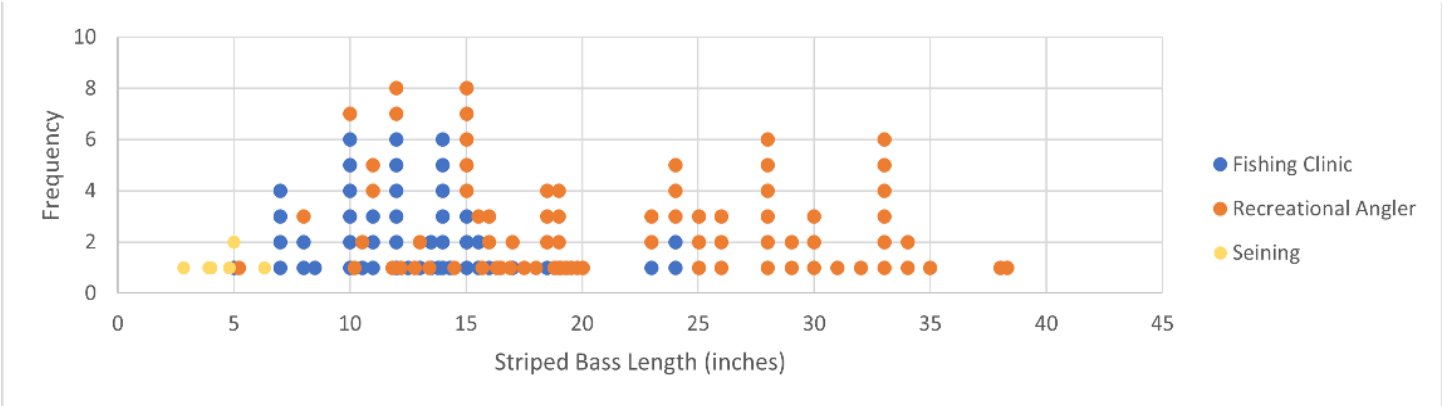
Community scientists who collected the striped bass data believe that the average size of striped bass caught is influenced by the type of fish capture method employed and skillset of the collector. To explore this hypothesis, review the averages below and complete the questions.

CATCH METHOD	AVERAGE SIZE OF STRIPED BASS (inches)
Seining	4.4
Rod & Reel Clinics	12.7
Recreational Angling	21.6
Trapping	5.0



1. Using the data above and graphing area, create a bar chart showing the average striped bass size for each collection method.
2. What method of fishing had the highest average striped bass size?
3. Which method of fishing had the lowest average striped bass size?

4. Look at the figure below. The distribution of striped bass sizes based on collection method varies significantly. Why do you think this distribution occurs?



ANSWER KEY

EXERCISE 1: Salinity of the East River

The East River is not a true river but rather a tidal strait that connects the Upper NY Harbor to the Long Island Sound and the Harlem River. It is also considered a part of the New York Harbor Estuary. Estuaries have brackish water, meaning they are a mixture of saltwater and freshwater. The saltiness, or salinity, of a waterbody is measured in a unit called parts per thousand.

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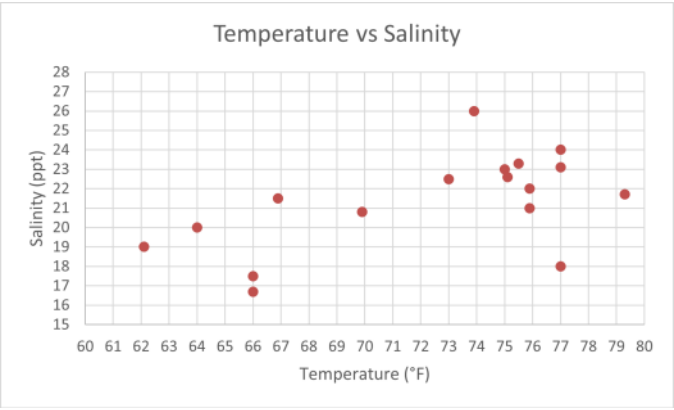
6/22/2019	69.9	20.8
6/26/2019	73	22.5
7/11/2019	79.3	21.7
7/13/2019	75.9	21
7/15/2019	75.9	22
7/16/2019	75	23
7/24/2019	77	18
7/25/2019	80.6	26.5
8/7/2019	77	23.1
8/10/2019	77	24
8/14/2019	75.5	23.3
8/31/2019	75.1	22.6
9/7/2019	73.9	26
10/8/2019	66.9	21.5
10/22/2019	62.1	19

1. On which date was the water temperature the highest? Lowest?
   Highest: 7/25 Lowest: 6/1

2. On which data was the salinity the highest? Lowest?
   Highest: 7/25 Lowest: 6/12

3. Create a scatter plot using graph paper. Place temperature on the x axis and use the range 60-80. Place salinity on the y axis using the range 15-28.



4. Do you notices any trends in your scatter plot? What do you notice about dates where the temperature is higher?

Salinity tends to be a little higher on days where the temperature of the water is higher.

(This is likely due to evaporation on warmer days, which leaves behind salt thus increasing the ratio of salt to water.)

ANSWER KEY

EXERCISE 2:
Investigating Dissolved Oxygen Levels

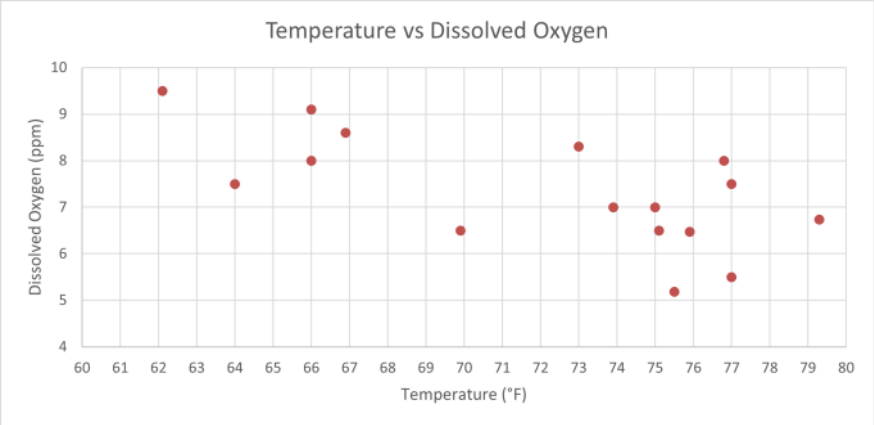
Dissolved oxygen is essential for marine life to survive. Dissolved oxygen enters the water through the atmosphere and photosynthesis of aquatic plants. Most marine animals cannot tolerate waters with less than 4 parts per million (ppm) of dissolved oxygen. Colder water typically can hold more dissolved oxygen than warmer water.

Data on water temperature and dissolved oxygen was collected at the Pier 4 Beach in Brooklyn Bridge Park throughout the summer of 2019. Look over the data, then answer the questions below.

Date	Variable 1 (x): **Temperature (°F)**	Variable 2 (y): **Dissolved Oxygen (ppm)**
5/30/2019	66	9.1
6/1/2019	64	7.5
6/12/2019	66	8
6/22/2019	69.9	6.5
6/26/2019	73	8.3
7/11/2019	79.3	6.73
7/13/2019	75.9	6.47
7/24/2019	77	5.5
7/25/2019	75	7
8/7/2019	76.8	8
8/10/2019	77	7.5
8/14/2019	75.5	5.18
8/31/2019	75.1	6.5
9/7/2019	73.9	7
10/8/2019	66.9	8.6
10/22/2019	62.1	9.5

1. On the warmest day, what was the dissolved oxygen level? On the coolest day, what was the dissolved oxygen level?
   Warmest day: 7 ppm Coolest day: 9.5

2. Create a scatter plot using graph paper. Place temperature on the x axis and use the range 60-80. Place dissolved oxygen on the y axis using the range 4-10.



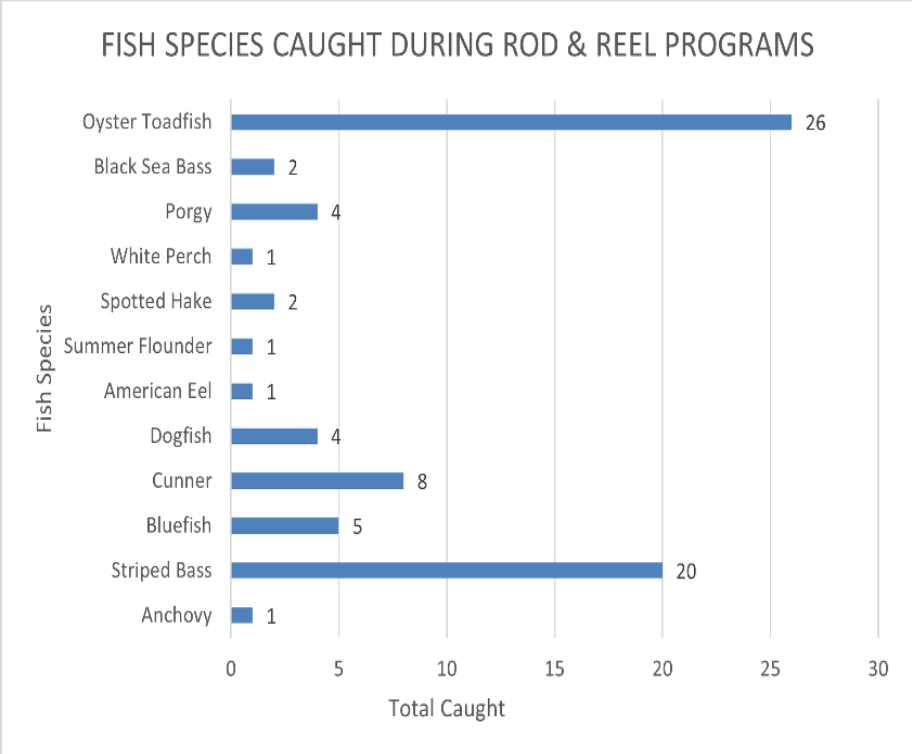
3. Do you notices any trends in your scatter plot? What do you notice about the dissolved oxygen levels on days where the temperature is higher?
   As temperature increases, dissolved oxygen decreases.

4. The data above was mostly collected in summer months (June, July, August). Do you think that the average dissolved oxygen level would be much different in the winter months (December, January, February)? Explain.
   The average dissolved oxygen level is likely get higher as the water temperature continues to drop., due to their inverse relationship. Day to day and hour to hour variability would continue to be likely, due to

ANSWER KEY

EXERCISE 3: Evaluating Fish Collection Methods

Seining is a method of fishing where a long net is dragged through the water to gently scoop up fish. **Rod and reel** fishing entails using a hook, bait, and fishing line to catch a single fish. It is also referred to as angling. The Brooklyn Bridge Park Conservancy tracked the number of each fish species caught during every seining program and rod and reel program in 2019. The total number of species caught with each fishing method are illustrated in the figures below. Examine the two sets of data, then answer the questions .



FISH SPECIES CAUGHT DURING SEINING PROGRAMS	
American eel	2
Atlantic menhaden	104
Atlantic silverside	1435
Atlantic tomcod	44
bay anchovy	68
bluefish	28
cunner	1
flounder	3
herring	10
Atlantic needlefish	4
Northern pipefish	10
oyster toadfish	2
porgy	2
Northern puffer	2
silver perch	60
skilletfish	8
spot	3
striped anchovy	3
striped bass	8
tautog	9
white perch	1
TOTAL FISH CAUGHT	**1807**

1. Which species was mostly commonly caught during rod and reel fishing?
   Oyster Toadfish
2. Which species was most commonly caught during seining?
   Atlantic Silverside
3. What was the total number of fish caught during rod and reel fishing?
   84 (Students will need to add the values listed in the bar graph)
4. Which method of fishing collected more fish in total? Why do you think that was the case?
   Seining caught significantly more fish. This is most likely due to the ability for a seine net to capture more fish at a time. Many of the fish in the seining area are schooling fish, which means they tend to travel together in large groups.
5. How many unique species of fish were caught from seining? From rod &reel? Speculate why there is a difference. Seining= 21 unique species. Rod= 12 unique species. Possible rationales include, more fish prefer the habitat near seining than the depp not all fish species may have been attracted to the bait require to catch a fish on a rod, more time may have been spent seining than with rod and reel.

ANSWER KEY

EXERCISE 4: Striped Bass Catch Size in Brooklyn Bridge Park

Throughout the summer of 2019, the Brooklyn Bridge Park Conservancy conducted numerous catch and release fishing days, using either a seine net or fishing rods. Each fish was measured in cm. The measurements can be seen below.

42.0	35.5	30.5
33.1	40.6	31.7
38.1	30.5	38.1
43.0	46.9	44.5
35.5	46.9	34.3
58.4	34.3	40.6
36.2	36.8	34.3

Students should start by listing all the measurements out in order from smallest to largest.

Mode is the most frequent number listed. Median is the middle, in this case the 11th number in the ordered data. Mean (average) can be calculated by adding all the measurements and dividing by 21.

30.5
30.5
31.7
33.1
34.3
34.3
34.3 ← 1st Q
35.5
35.5
36.2
36.8 ← MEDIAN
38.1
38.1
40.6
40.6
42.0 ← 3rd Q
43.0
44.5
46.9
46.9
58.4

1. Determine the following statistics for this dataset. Show your work.
   MODE: 34.3

   MEADIAN: 36.8

   MEAN: 38.7

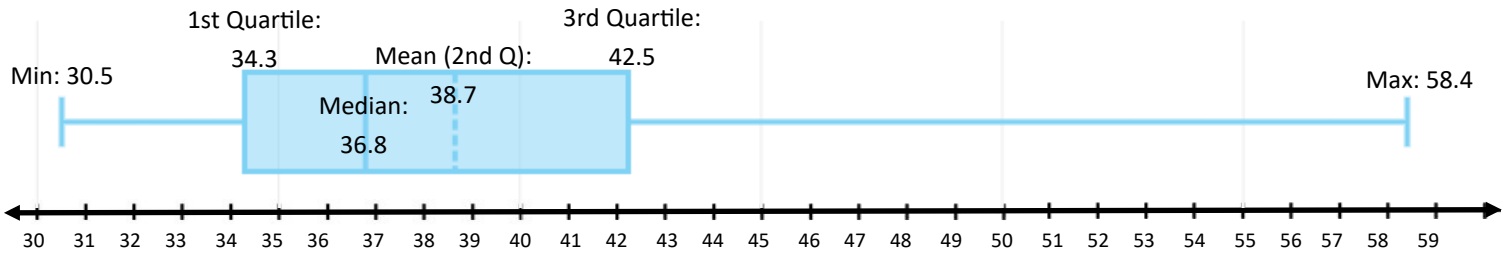
2. Are there any outliers? Yes, 58.4

3. What is the maximum and minimum value? What is the range?
   Min = 30.5 Max= 58.4 Range= 27.9 (max minus min)

4. What is the lower quartile (first quartile)? Upper quartile (third quartile)?
   Lower quartile (first quartile)= 34.3
   Upper quartile (third quartile)= 42.5

   To calculate 1st quartile, students will need to find the median of the first half of the data (30.5 to 36.8) To calculate 3rd quartile, students will need to find the median of the second half of the data (36.8 to 58.4)

5. Using your calculations, create a box plot below.

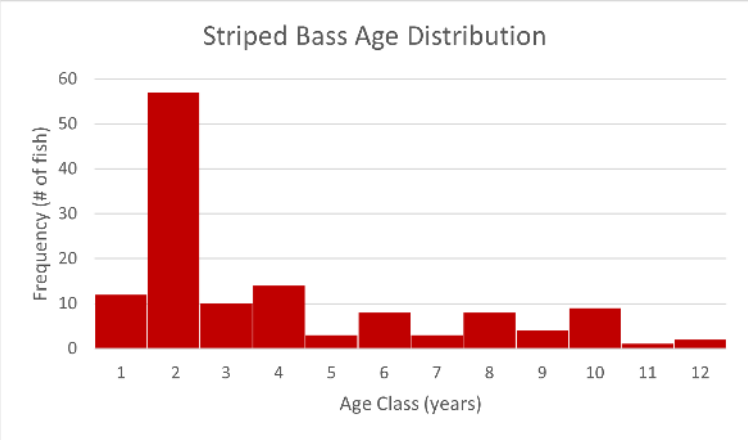


ANSWER KEY

EXERCISE 5: Analyzing Striped Bass size and age in the East River

Throughout the summer of 2019, 131 striped bass were monitored in the East River through fishing efforts such as seining, rod and reel, and traps. The total length from mouth to tail was recorded in mm for each specimen (Table B). The age of a striped bass can be approximated based on it's total length (Table A). Follow the steps below to determine the age distribution of striped bass caught.

1. Convert the data from mm to cm. Fill in the converted data into Table B. (answers in table)
2. Determine the age category of each specimen using Table A and record it in Table B. (answers in table)
3. Count or tally the frequency (total number of measurements) that matches each age class. Record in Table A. Double check you work. There are 131 data entries total. (answers in table)
4. Using graphing paper, make a histogram.



5. Which age was the most common catch?
   2 years

TABLE A: STRIPED BASS AGE BASED ON SIZE

Size Range (cm)	Age Class	Frequency
0- 19.9	1 year	12
20 - 39.9	2 years	57
40 - 45.9	3 years	10
46—53.5	4 years	14
53.6 -58.5	5 years	3
58.6 - 63.5	6 years	8
63.5 - 68.5	7 years	3
68.6– 73.6	8 years	8
73.7 - 78.7	9 years	4
78. 8 - 86.4	10 years	9
86. 5 - 91.4	11 years	1
91.5 +	12 plus years	2

TABLE B: STRIPED BASS SPECIMEN LENGTHS

Size (mm)	Size (cm)	Age Class
889	88.90	11
711.2	71.12	8
71.1	7.11	1
99.1	9.91	1
101.6	10.16	1
121.9	12.19	1
127	12.70	1
127	12.70	1
132.1	13.21	1
160	16.00	1
177.8	17.78	1
177.8	17.78	1
177.8	17.78	1
177.8	17.78	1
203.2	20.32	2
203.2	20.32	2
203.2	20.32	2
215.9	21.59	2
254	25.40	2
254	25.40	2
254	25.40	2
254	25.40	2
254	25.40	2
254	25.40	2
254	25.40	2
259.1	25.91	2
266.7	26.67	2
266.7	26.67	2
279.4	27.94	2
279.4	27.94	2
279.4	27.94	2

DATASET CONTINUES ON NEXT PAGE →

ANSWER KEY

TABLE B: STRIPED BASS SPECIMEN LENGTHS (CON'T)

Size (mm)	Size (cm)	Class category
304.8	30.48	2
304.8	30.48	2
309.9	30.99	2
317.5	31.75	2
325.1	32.51	2
330.2	33.02	2
330.2	33.02	2
340.4	34.04	2
342.9	34.29	2
342.9	34.29	2
350.5	35.05	2
355.6	35.56	2
355.6	35.56	2
355.6	35.56	2
355.6	35.56	2
355.6	35.56	2
355.6	35.56	2
363.2	36.32	2
368.3	36.83	2
381	38.10	2
381	38.10	2
381	38.10	2
381	38.10	2
381	38.10	2
381	38.10	2
381	38.10	2
381	38.10	2
393.7	39.37	2
393.7	39.37	2
393.7	39.37	2
398.8	39.88	2
406.4	40.64	3
406.4	40.64	3
406.4	40.64	3
414	41.40	3
419.1	41.91	3
429.3	42.93	3
431.8	43.18	3
431.8	43.18	3
444.5	44.45	3
457.2	45.72	3
469.9	46.99	4
469.9	46.99	4
469.9	46.99	4
469.9	46.99	4
477.5	47.75	4
482.6	48.26	4
482.6	48.26	4
482.6	48.26	4
482.6	48.26	4

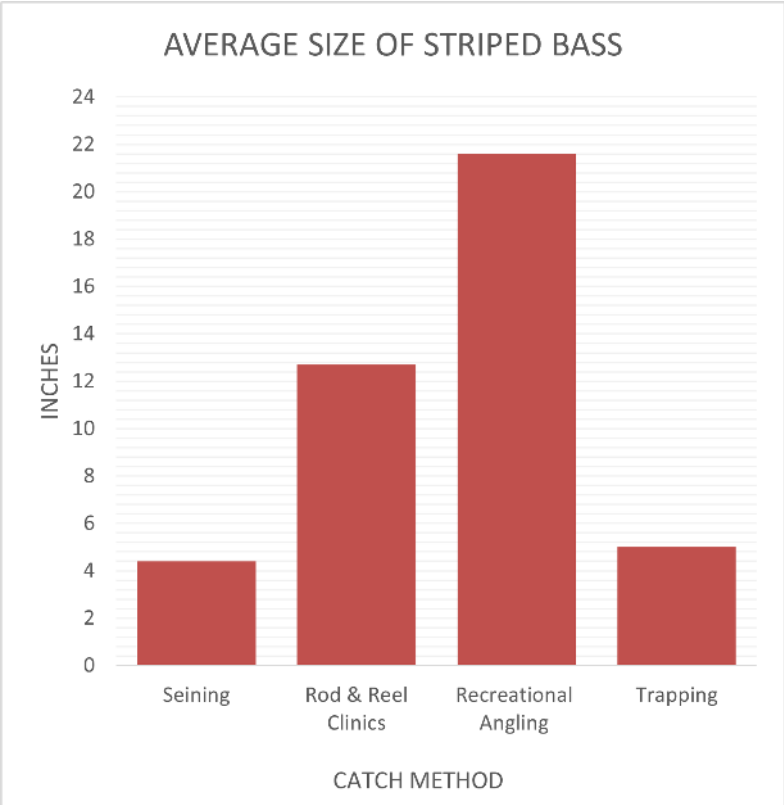
Size (mm)	Size (cm)	Class category
485.1	48.51	4
490.2	49.02	4
495.3	49.53	4
502.9	50.29	4
508	50.80	4
584.2	58.42	5
584.2	58.42	5
584.2	58.42	5
609.6	60.96	6
609.6	60.96	6
609.6	60.96	6
609.6	60.96	6
609.6	60.96	6
635	63.50	6
635	63.50	6
635	63.50	6
660.4	66.04	7
660.4	66.04	7
660.4	66.04	7
711.2	71.12	8
711.2	71.12	8
711.2	71.12	8
711.2	71.12	8
711.2	71.12	8
736.6	73.66	8
736.6	73.66	8
762	76.20	9
762	76.20	9
762	76.20	9
787.4	78.74	9
812.8	81.28	10
838.2	83.82	10
838.2	83.82	10
838.2	83.82	10
838.2	83.82	10
838.2	83.82	10
838.2	83.82	10
863.6	86.36	10
863.6	86.36	10
965.2	96.52	12
972.8	97.28	12
279.4	27.94	2
279.4	27.94	2
299.7	29.97	2
304.8	30.48	2
304.8	30.48	2
304.8	30.48	2
304.8	30.48	2
304.8	30.48	2
304.8	30.48	2

ANSWER KEY

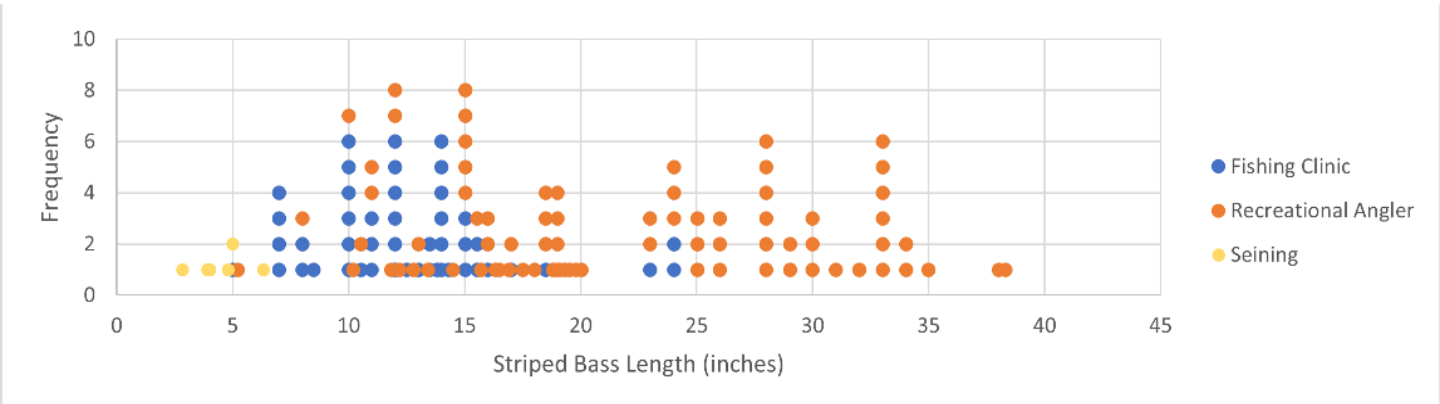
EXERCISE 6: Comparing Striped Bass Size to Collection Method

Community scientists who collected the striped bass data believe that the average size of striped bass caught is influenced by the type of fish capture method employed and skillset of the collector. To explore this hypothesis, review the averages below and complete the questions.

CATCH METHOD	AVERAGE SIZE OF STRIPED BASS (inches)
Seining	4.4
Rod & Reel Clinics	12.7
Recreational Angling	21.6
Trapping	5.0



1. Using the data above and graphing area, create a bar chart showing the average striped bass size of each collection method.
2. What method of fishing had the highest average striped bass size?
   Recreational angling
3. Which method of fishing had the lowest average striped bass size?
   Seining

4. Look at the figure below. The distribution of striped bass sizes based on collection method varies significantly. Why do you think this distribution occurs?

Seining tends to catch younger, smaller fish. Recreational anglers have a lot more expertise at using a rod than the participants in fishing clinics who were often youth and first time fishers, therefore over the fishing season recreational anglers probably had greater success at catching large stripers. Location fish were caught could also have an influence, because expert anglers know prime fishing spots.